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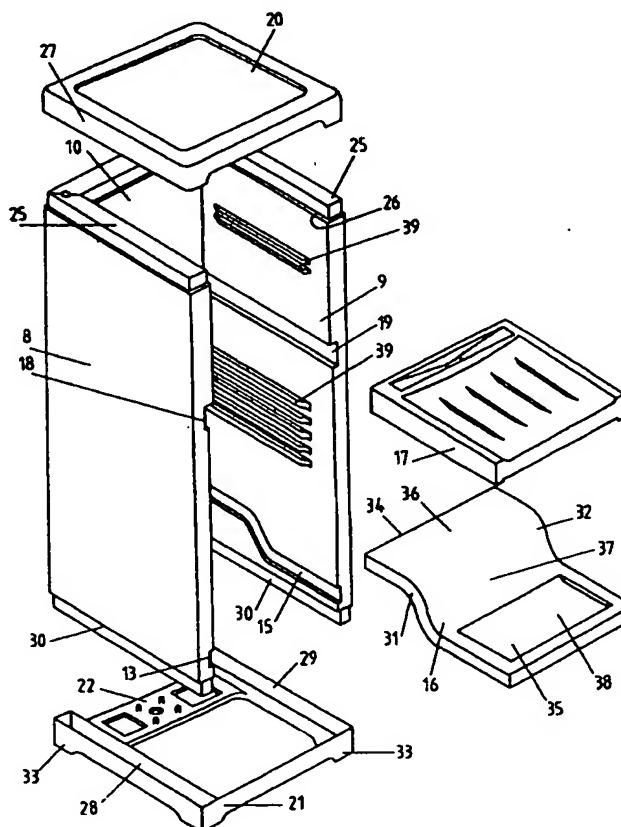


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(21) International Application Number: PCT/NZ98/00134 (22) International Filing Date: 9 September 1998 (09.09.98) (30) Priority Data: 328703 9 September 1997 (09.09.97) NZ (71) Applicant (for all designated States except US): FISHER & PAYKEL LIMITED [NZ/NZ]; 78 Springs Road, East Tamaki, Auckland (NZ). (72) Inventors; and (75) Inventors/Applicants (for US only): VAUGHAN, Stewart [NZ/NZ]; 21 Hoheria Street, One Tree Hill, Auckland (NZ). WITTEN-HANNAH, Daniel [NZ/NZ]; 33 Nottingham Street, Westmere, Auckland (NZ). (74) Agents: CALHOUN, Douglas, C. et al.; A J Park & Son, Huddart Parker Building, 6th floor, Post Office Square, P.O. Box 949, Wellington 6015 (NZ).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

(54) Title: A CABINET, PARTS THEREOF AND ASSOCIATED METHODS**(57) Abstract**

A cabinet for a refrigerator is formed from a twin sheet thermoformed panel (1) divided into a plurality of wall sections (8, 9, 10) by seams (6) where the twin sheets (2, 3) contact. The panel is folded to form the rear (10) and two side walls (8, 9) of a refrigerator cabinet, and top end cap and a base plinth are fitted to retain the walls in position. Refrigeration system components are carried on the base plinth. The walls (8, 9) and back (10) are secured by having their upper and lower edges (25, 30) fitted within peripheral channels (28, 29) on the top end cap (20) and the base plinth (21). Additionally they may be further secured by fusing contacting portions (65, 76) of the inner sheet of the panel in the region adjacent folded seams (6). The panel is preferably filled with rigid insulating foam while still supported on the thermoforming mould. The seams (6) are preferably provided on the back face (61) of the cabinet, spaced from the corners between side and rear faces, providing improved aesthetics with the fold lines hidden. An improved heater for softening seams between wall sections is disclosed.



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“ A CABINET, PARTS THEREOF AND ASSOCIATED METHODS”

TECHNICAL FIELD

This invention relates to cabinets, parts of cabinets prior to final assembly and to methods of forming cabinets and, in particular, to insulated refrigerator cabinets and methods of forming same.

BACKGROUND ART

At present the construction of domestic refrigerators, particularly the cabinets, are commonly made from a formed steel exterior, which is either pre-painted or post-painted, into which a thermoformed plastic interior is placed locating in a roll formed edge. A steel or plastic base is attached to the bottom and top of this assembly along with a back panel of similar materials to create a closed cavity between the exterior and interior. This assembly is placed into a jig that supports the walls of the cabinet whilst insulation is injected and expanded into the cavity. Associated with this type of construction are additional processes that seal the joints between the individual parts in order to prevent the expanded foam from leaking.

US Patent 4,580,852 shows a refrigerator incorporating a cabinet of this type. The major drawbacks with this type of construction and manufacturing process are the number of individual parts, processes, and their associated costs. In addition to this the processes are time consuming and labour intensive.

US Patent 5,374,118 assigned to Whirlpool Corporation shows a refrigerator cabinet wherein the side walls and top are formed by twin-wall thermoforming as a single part. They are folded and a back is fitted to the cabinet to support them in position. The back of the cabinet incorporates the refrigeration system. While this system offers a significant improvement over the prior art, difficulties are perceived with the overall cabinet space occupied by the refrigeration system carrying back unit and with difficulties of connecting and sealing the back unit to the remainder of the refrigerator cabinet.

DISCLOSURE OF THE INVENTION

It is therefore an object of the present invention to provide a cabinet and/or parts thereof and/or a method of forming same which will go some way towards overcoming the above disadvantages or will at least provide the public with a useful choice.

In one aspect the invention consists in a refrigerator cabinet comprising:

a twin walled insulated plastic member divided, by a plurality of elongate seams at which said twin walls contact, into three or more wall sections disposed sequentially in a side by side relation, said member folded at said seams such that said sequence of

wall sections form three or more sides of a cabinet connected at said elongate seams, said sides defining a refrigeration space there between,

a top end cap connected to the top edge of said wall member retaining said wall member in said folded configuration, said top end cap enclosing the top end of said refrigeration space,

a base plinth connected to the bottom edge of said wall member retaining said wall member in said folded configuration, said base plinth supporting, directly or indirectly, mechanical components of said refrigeration system, and

floor means, integral with or separated from said base plinth, to enclose the bottom end of said refrigeration compartment.

In a still further aspect the invention consists in a refrigerator including a refrigerator cabinet as described above, a door mounted on said refrigeration cabinet to enclose the front side of said refrigeration space and thereby fully enclose said refrigeration space, and a refrigeration system to refrigerate said refrigeration space, at least a part of said refrigeration system being mounted on said base plinth,

In a still further aspect the invention consists in a method of forming a refrigerator cabinet comprising the steps of

- (a) thermoforming a twin walled insulated plastic member divided, by a plurality of elongate seams at which said twin walls contact, into three or more wall sections disposed sequentially in a side by side relation,
- (b) folding said plastic wall member along each said seam to form three or more sides of a cabinet connected at said elongate seams, said sides defining a refrigeration space therebetween, and
- (c) fitting a top end cap to said cabinet to retain said wall member in said folded configuration and enclose the top end of said refrigeration space, and
- (d) fitting a base plinth to the bottom edge of said wall member to retain the bottom edge of said wall member in said folded configuration.

In a still further aspect the invention consists in a refrigeration cabinet formed by a method in accordance with one or more of the above paragraphs.

In a still further aspect the invention consists in a cabinet including:

a twin walled plastic member divided, by a plurality of elongate seams at which said twin walls contact, into three or more wall sections disposed sequentially in a side by side relation, said member folded at said seams such that said sequence of wall sections form three or more sides of a cabinet connected at said elongate seams, and

a top and/or a bottom end cap, having generally an interior and an exterior face and having on the inner face along at least two sides thereof at or adjacent the periphery

thereof a recessed channel, the top and/or bottom edge respectively of said folded plastic wall member fitted into said channel or channels, said channel or channels retaining said wall member in said folded configuration.

In a still further aspect the invention consists in a cabinet for an appliance including a wall member formed by twin sheet thermoforming, said wall member incorporating a plurality of panels, said panels connected to one another by one or more joined edges where said twin sheets contact to form a seam, and in said appliance said wall member being in a folded condition along one or more of said seams such that said plurality of panels form a plurality of walls of said appliance, being, as a group, differently configured to when said wall member was initially thermoformed, wherein one or more of said folded seams do not coincide with the corner between walls of said appliance that correspond to the panels joined by the respective folded seam.

In a still further aspect the invention consists in a cabinet for an appliance including a wall member formed by twin sheet thermoforming, said wall member incorporating a plurality of panels, said panels connected to one another by one or more joined edges where said twin sheets contact to form a seam, and in said appliance said wall member being in a folded condition along one or more of said seams such that said plurality of panels form a plurality of walls of said appliance, being, as a group, differently configured to when said wall member was initially thermoformed, at least one said seam said twin walled plastic member having essentially an inner facing sheet and an outer facing sheet, and said member is formed adjacent at said seam such that in said folded condition said inner facing sheet contacts itself, said contact being between portions thereof on opposite sides of said seam and spaced from said seam, said contacting portions being fused to one another.

In a still further aspect the invention consists in a wall member formed by twin sheet thermoforming including one or more seams where said twin sheets contact, said wall member adapted to be folded at one or more of said seams to form a plurality of walls, characterised in that at least one said seam is intended to be folded through a set angle, and that at least one said sheet of said twin sheets includes, at or substantially at said seam, a transition between surfaces thereof which is the complement of the said set angle, such that if said seam is folded through said set angle, said surfaces will be substantially continuous across said seam.

In a still further aspect the invention consists in apparatus for preparing a twin sheet thermoformed wall member, including one or more seams at which said wall member is to be folded bringing included faces of said wall member at said seam together, for folding comprising a heat conductive head having a heating face configured to contact along said

seams to be folded at, means to heat said heat conductive head, said head supported on a support means, which, together with a support means associated with said wall member is adapted to bring said head heating face into contact with said seam and by that contact allow the transfer of heat from said head to said seam and thereby soften said seam for folding.

In a still further aspect the invention consists in a cabinet for a refrigerator substantially as herein described with reference to and as illustrated by Figures 1 to 5 of the accompanying drawings.

In a still further aspect the invention consists in a cabinet for a refrigerator substantially as herein described with reference to and as illustrated by Figures 6 and 7 of the accompanying drawings.

In a still further aspect the invention consists in a method of forming a refrigerator cabinet substantially as herein described with reference to and as illustrated by the accompanying drawings.

In a still further aspect the invention consists in a cabinet for an appliance including a corner arrangement substantially as herein described with reference to and as illustrated by Figure 9 of the accompanying drawings.

To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described in detail with reference to the accompanying drawings in which;

Figure 1 is a cross-sectional end elevation through a thermoforming mould for forming the twin sheet wall forming panel of the present invention, in a closed configuration,

Figure 2 is a cross-sectional side elevation on A-A of the mould of Figure 1 during a foaming operation,

Figure 3 is a perspective view of the twin sheet panel of a first embodiment of the present invention subsequent to removal from the mould,

Figure 4 is a partial perspective view in cross-section of an end edge of the panel immediately after removal from the mould,

Figure 5 is an exploded perspective view of a refrigerator cabinet assembly

according to the present invention,

Figure 6 is a perspective view in cross section of a twin sheet panel according to an alternative embodiment of the present invention,

Figure 7 is an exploded perspective view of a refrigerator cabinet assembly according to said alternative embodiment,

Figure 8 is a cross sectional plan elevation through the portion of a twin sheet panel according to the preferred embodiment of the present invention that, when folded up to form a refrigerator cabinet assembly, will form a corner between the back and a side thereof, and additionally showing a tool for heating and softening parts of one or both of the twin sheets, and

Figure 9 is a cross sectional plan elevation through the refrigerator cabinet corner formed from that panel portion of Figure 8.

BEST MODES FOR CARRYING OUT THE INVENTION

With reference to Figure 5, a cabinet is shown for a refrigerator which has side walls 8,9 and a rear wall 10 which are integrally connected at hinged regions 6. The side walls 8,9 and rear wall 10 are folded at the hinged regions to form the sides 8,9 and rear wall 10 as shown. The walls 8,9,10 are retained in the folded condition by a top cap 20 and by a base plinth 21. The top cap also serves to enclose the top end of the refrigeration chamber defined by the side walls 8,9 and back wall 10. A floor partition 16 is disposed within the chamber to enclose the bottom side of the refrigeration chamber. The base plinth 21 is disposed with connections 22 for mounting elements of the refrigeration system, notably the compressor, control system and expansion valve. The base plinth 21 may otherwise remain substantially open. For refrigerator configurations incorporating a fresh food refrigeration compartment and a freezer compartment, a compartment divider 17 is provided.

With reference to Figure 7 an alternative embodiment is shown wherein the bottom partition is incorporated in the base plinth in an integrated manner as a floor member 50. The floor member 50 defines a space there below bordered by side footings 52. Refrigeration system mechanical components are located on connections 54 of a carrying tray 53 which is slidably fitted within the space below the floor member 50 and supported by the side footings 52.

The method of forming the side and back walls 8,9,10 will be described later with reference to Figures 1-4, as will the overall assembly of the refrigerator.

With reference to Figures 5 and 7 the top cap 20 of the refrigerator both encloses the top end of the refrigeration space and also retains the top edge 25 of the walls 8-10

within a channel formed on the lower face thereof. The top edge 25 of the walls 8-10 is preferably formed with a rebate 26, thereby forming a tongue-like projection, so that when fitted, the outer side faces and end face 27 of the top cap 20 sit flush with the external surfaces of the side and rear walls 8-10.

Similarly the base plinth 21 is provided with channels 28 and 29 adjacent the side extremities thereof. The channels 28, 29 accommodate tongue portions 30 of the lower edge of the side walls 8 and 10. Once more the tongued or rebated configuration allows the side faces of the base plinth to sit flush with the side surfaces of the refrigerator cabinet. As can be seen from Figure 5 in conjunction with Figure 3, the rear wall 10 of the cabinet preferably finishes at a point above the lower edge of the side walls 8 and 9. This leaves an opening at the rear of the refrigerator for access to the refrigeration system components (mounted on the base plinth connections 22 in figure 5 and on support tray 51 in figure 7), and allows air flow therearound as necessary. The base plinth 21 also preferably includes foot portions 33 extending slightly downwardly therefrom to support the refrigerator cabinet on a supporting surface. Adjustable feet as are known in the prior art may be fitted as required.

With reference to Figure 5 floor partition 16 is preferably disposed with the side edges 31, 32 thereof disposed within channels 13, 15 formed in the interior side walls of the refrigerator cabinet and the rear edge 34 thereof disposed in recessed channel 14 along the lower edge of the rear wall. The floor preferably includes a transition from a substantially horizontal forward portion 35 to a substantially horizontal rearward portion 36 via a sloped and curved transition region 37. The floor partition may also include interior detailing such as drip tray 38.

With reference to Figures 6 and 7, in the alternative embodiment the floor preferably includes a similar transition between a front plateau 55 and a rear plateau 56. The interior faces of the side walls of the refrigerator cabinet are formed with a shaped rebate 57,58 therein, the upper edge of which generally follows the contour of the upper lateral edges of said floor member, with the raised part of said base plinth being located within the rebate 57,58.

With reference to Figures 5 and 7 the walls 8, 9 and rear wall 10 of the cabinet may have their internal faces thereof formed with detailing such as tray supporting rails 39 formed integrally therein. Other manners of applying such details to these walls may also be apparent to persons skilled in the art, for example, by plastic welding fascia panels to flat surfaces, however this seen as a rather inefficient manner of forming such detailing.

Similarly the divider 17 may contain additional details for door hinging, air ducting and interior styling.

With reference to Figures 1 and 3 the side walls 8,9 and rear wall 10 of the cabinet are formed by simultaneously thermoforming the exterior and interior of the cabinet as a single flat panel 1 from two plastic sheets 2,3 that can be of differing thicknesses, colours or material composition. The sheets 2, 3 are heated and are initially held at their periphery by supporting flanges 12. Air is injected between the sheets 2,3 as the moulds, interior 4 and exterior 5, are closed over the sheets 2,3 assisting in the thermoforming process. The above aspects of the twin-sheet thermoforming process itself is known in the art and will not be described in detail herein.

The correspondingly formed panel 1 has two folding/hinging regions 6 placed into it by ridges 7 in the profile of the interior mould 4. The hinging regions 6 divide the panel into three cavities, two side walls 8,9 and a rear wall 10. In the hinging region the interior sheet 4 is attached to the exterior sheet 5 to form the folding line.

With reference to Figure 4, after thermoforming the panel remains in the mould and insulating foam 40 is injected into the three cavities through are injection holes 11 from the thermoforming process. The thermoforming mould 4,5 then acts at a foaming jig, supporting the walls whilst the foam expands and sets.

After sufficient time for the foam to cure, the foamed panel is then removed from the mould 4,5 and the supporting flanges 12. With reference to Figure 4, during removal from the mould or some time thereafter and before assembly, excess material 40 is trimmed from the moulded member 1. The material is preferably trimmed flush with the join 41 between internal and external sheets, to leave a clean exterior finish. Exposed joins may be finely polished to provide an aesthetic finish.

Referring to Figure 8 an advantageous configuration of the corner area of a the thermoformed panel is shown. The corner area is between a side wall 8 and the rear wall 10 of the refrigerator, with the twin sheets essentially being assigned as either an inner sheet or an outer sheet, depending on whether they form the inner faces of the corner or the outer faces. The corner is intended to be formed by folding the panel through a set angle at the seam 6 where the inner and outer sheets contact, the angle corresponding to the intended angle between the walls when assembled. To this end the regions 64, 68 of the inner sheet approaching the seam include an angle substantially the same as the set angle, so that when the panel is folded at the seam these regions will be substantially adjacent and there will not be a significant opening or crevice there between. Configurations are of course possible where this included angle is biased toward one sheet or another, with a seam with width approximately the same as the thickness of the panel being one extreme possibility. However in the preferred embodiment, for better overall strength and ease of forming, the included angle is embodied as a pair of faces 64,

68 which are at a general angle of 45 degrees to the general plane of the sheet, to thereby mutually include an angle of approximately 90 degrees.

The outer sheet is configured to with a transition at the seam of the thermoformed panel, between the outer face 61 of the panel section 8 that will broadly form the back wall, and the minor outer face 62 of the panel section 10 that will broadly form the side wall, which is basically the complement of the set angle through which the panel is to be folded at the seam 6. With the outer sheet thus configured, when the sheet is folded through the set angle the face 61 and the face 62 will become aligned across the seam to form a substantially continuous plane, the back wall surface. There is of course a further transition in the outer sheet, falling in that part of the panel that will form the side wall, and the transition being between the minor face 62 and the major face 63 of that panel section, with that transition, when folded, forming the corner of the cabinet. In this way the seam between the side and rear panels of the cabinet is provided along a line that is parallel with and near the corner, but is not at the corner, and so can be hidden on the back face of the refrigerator, which in nearly all installations will be fairly well hidden from view. This is depicted in Figure 9 which shows the panel in its folded configuration, the seam 6 being clearly disposed on the back face of the refrigerator cabinet. Other configurations of these transitions are of course possible depending on the angles through which the panel is to be folded, possible overall curvatures of the panel sections and possible curvature of the corner itself, without departing from the general intention of this aspect of the invention.

With continued reference to Figures 8 and 9 aspects of the preferred folding process are depicted. In the prior art systems that have suggested folding twin sheet panels at a seam, the seam has been heated by disposing a radiant heater, such as a wire of high electrical resistance, in close proximity to the seam immediately prior to folding, to soften the seam. However with a panel of the size necessary to form the walls of a refrigerator cabinet it has been found that such techniques are inappropriate, for example due to wire sag, and the ability to hold the heater sufficiently close to heat the seam without also heating and thereby facilitating deformation of the surrounding sheet. Therefor in the preferred assembly method a heater is provided in which a highly conductive heater head 74 is supported on a heater support member 72, which is moveable relative to the panel to bring a heating face 77 thereof into contact with the seam 6 of the panel. The heater head and heating face are preferably substantially coextensive with the seam 6. To facilitate this contact the seam region may be formed having a significant width, and may include a greater heat receiving surface, such as by the inclusion of chamfer 69 on the inner side thereof. This heating operation may advantageously be provided while the panel

is still supported on its lower mould, however it may equally be carried out with the panel supported on another supporting surface so long as it is reasonably accurately positioned with respect to the heater head 74 and head support member 72. It should be readily apparent that the use of a conductive heater head allows for a more localised heating, particularly as the conductive head is more readily formed from a solid and rigid material, such as an aluminium block. This lessens the adverse heating that is caused to adjacent areas of the sheet and reduces the heating time. The heat conductive block preferably includes a coating which helps the block release from the heated plastic material without deforming the plastic material. A PTFE coating has been found suitable for this purpose.

As already described the inner sheet of the panel includes an angle between the faces 68 and 64 which are to eventually nearly meet in the assembled construction. This similar angle also exists between at least the regions of faces 65 and 76 which are adjacent the faces 68 and 64, but further from the seam 6. Due to the step that is advantageously incorporated in the outer sheet (for reasons described above), these regions of the faces 65 and 76 will also come into close alignment and proximity. In the preferred embodiment of the invention the close proximity and alignment of the faces, 68 and 64 and/or 65 and 76, is used to provide a further fused joining between the panel sections, spaced away from the seam 6, to thereby permanently lock the panels into their folded configuration. To assist the fusing process nodules 66, 67 of plastic material are raised from the general surrounding surfaces 76, 65. The nodules may comprise localised raised areas, or may comprise ridges being substantially coextensive with the seam 6. The conductive heating head 74 is provided with further heating faces 61 and 73 and the heater support 72 is configured to bring these heating faces into contact with the nodules, 66 and 67 respectively, simultaneously with contacting face 77 against the seam 6. With the panel being subsequently folded while the nodules are substantially molten the nodules contact and fuse together to form a weld 75 between the faces 65 and 76 of the inner sheet of the panel. In use the weld not only provides a significant increase in the stiffness of the cabinet but also serves to seal the crevice between the faces 68, 64 of the inner sheet at a location near the surface of the crevice.

The corner is shown to be between the left side 8 and back 10 walls of the refrigerator cabinet but it is clearly applicable to other seams between sections of a thermoformed panel that are intended to be folded in formation of an article such as a cabinet, particularly where one of the external faces thereof is likely to be substantially hidden from view in general use.

In the embodiment of Figure 5 floor partition 16 is introduced into the assembly prior to the folding and is locked in place by a recess 13, 14, 15 formed in the side and

back walls of the folded panel once the side walls 8, 9 have been fully folded into position. The floor 16 is preferably a foam core sandwich with a plastic outer skin.

With reference to Figures 5 and 7 for dual temperature fridges a compartment divider 17 of similar construction to the floor 16 is inserted into channels 18, 19 formed in the side walls, as recess 20 extending across the panel (see Figure 3) to create the division between the freezer and refrigerator compartments. This divider 17 interlocks the sides 8, 9 of the folded panel 1 and is in turn locked in place by the restrained sides of the folded panel. The divider 17 contains additional details for door hinging, air ducting, and interior styling. The divider may be provided with a dove tail, mortise and tenon, connection to said side walls or may be provided with simple rectangular side edges.

With the divider and/or floor partition in place the top cap 20 is fitted to the top edge 25 of the folded panel. The tongue portion formed by rebate 26 fits within a channel in the underside of the top cap 20, to be retained thereby in the folded configuration.

The folded panel is further fitted with the base plinth 21 at the bottom edge thereof with the lower edge 30 of side walls 8 and 9, having the tongued portion thereof fitting within channels 28, 29 formed on the top face along the sides of the base plinth. The base plinth 21, like the top cap 20 retains the wall forming panel 1 in the folded configuration shown in Figures 5 and 7.

With further reference to Figure 7, some additional detail demonstrating how a refrigeration system may be incorporated in the refrigerator can be seen. In particular the refrigerator includes a baffle panel 80, 81 in each of the freezer and refrigerator compartments respectively, with each baffle panel forming the back wall of its respective compartment. Air recirculation ducts, which may be partially formed (for example the channel 82) in the twin sheet thermoformed panel, are concealed behind the baffles. The baffle for the freezer compartment is configured to be spaced forward of the inner face of the thermoformed panel, with its edges secured in grooves 83 in the side walls of the compartment, to provide a subcompartment therebehind. This subcompartment is utilised for housing the evaporator of the refrigeration system. One or more fans are positioned in the ducts which force the recirculation of air over the outer surface of the evaporator, with the cooled air then being passed into either the freezer or refrigeration compartment as desired, through the apertures 85, 86 in the respective baffle 80, 81. A channel 84 may be provided in the thermoformed panel to facilitate the egress of condensation which may form from time to time on the evaporator and be removed during a defrosting process. The channel 84 leads to a position just above the refrigerator compressor, where the condensation may fall into a tray mounted on the compressor head to thereby absorb heat from the compressor head and be evaporated away. Refrigeration systems of this general

configuration form are known in the art, and do not form a significant part of the present invention.

A refrigeration system as is known in the art, such as a standard vapour compression refrigeration system may be fitted to the cabinet. In such a system the compressor, condenser and any control system may be carried by the base plinth with the evaporator inside the refrigeration space, such as in the manner described above with reference to Figures 6 and 7. A door or doors is mounted on the fridge front, supported between hinge parts on the front edges of the top cap and base plinth and on the compartment divider panel. The doors are preferably also formed by twin sheet thermoforming with insulating foam injected into the cavity, as is known in the art.

The above description has been given with reference to refrigerator cabinets. The process is thought to be sufficiently versatile to also be appropriate for other cabinet types, particularly cabinets requiring a twin walled insulated structure. It is also readily apparent that while the above cabinet has been described as a pair of side walls and a rear wall, it would be a simple modification to incorporate any number of walls, with a corresponding change in the included angle between abutting transition faces.

It is readily apparent that the refrigerator cabinet according to the present invention, and as described above, includes significant advantages over the prior art. The refrigerator cabinet is provided with a simple construction having few parts, and which parts fit together in a manner so as to be self interlocking, giving the cabinet strength and rigidity. Cabinet dividers and partitions are engaged within the cabinet in an interlocking manner which provides good seals from both a thermal and moisture perspective, as does the engagement of the top cap with the top edge of the folded wall assembly. The base plinth, provided with the many mechanical elements of the refrigerator system is disposed beneath the bottom partition, easily accessible from the rear of the fridge, and minimising wasted potential refrigeration space within the refrigerator cabinet. It will also be appreciated that smooth curves and exterior lines will be readily possible, moulded into the exterior shape of the top cap, and into the outer sheet of the folded panel.

It will also be readily appreciated that the simplicity of assembly means the refrigerator cabinet of the present invention can be shipped in a knockdown form, with final assembly taking place at an entirely separate and potentially distant location than component production. This will provide significant benefits in shipping costs, where costs for low density products (such as refrigerators) are usually based on volume rather than weight.

CLAIMS:**1. A refrigerator cabinet comprising:**

a twin walled insulated plastic member divided, by a plurality of elongate seams at which said twin walls contact, into three or more wall sections disposed sequentially in a side by side relation, said member folded at said seams such that said sequence of wall sections form three or more sides of a cabinet connected at said elongate seams, said sides defining a refrigeration space there between,

a top end cap connected to the top edge of said wall member retaining said wall member in said folded configuration, said top end cap enclosing the top end of said refrigeration space,

a base plinth connected to the bottom edge of said wall member retaining said wall member in said folded configuration, said base plinth supporting, directly or indirectly, mechanical components of said refrigeration system, and

floor means, integral with or separated from said base plinth, to enclose the bottom end of said refrigeration compartment, .

2. A refrigerator cabinet as claimed in claim 1 wherein said top end cap has generally an interior and an exterior face and has on the interior face, along at least two sides thereof, at or adjacent the periphery thereof, a recessed channel, the top edge of said folded plastic wall member fitted into said top end cap channel, said top end cap channel retaining the top edge of said wall member in said folded configuration.

3. A refrigerator cabinet as claimed in claim 2 wherein the parts of said top and bottom edges of said wall member which fit in said channels of said top end cap and/or base plinth channels, are formed as a tongue extending therefrom, said tongue being of lesser thickness than the general thickness of said wall member, the tongue being fitted in the channel, such that the side and rear facing faces of the top end cap and base plinth are flush with the cabinet sides formed by the folded plastic wall member.

4. A refrigerator cabinet as claimed in any one of claims 1 to 3 wherein said twin walled insulated plastic member is generally configured with an inner facing and an outer facing plastic sheet, said inner facing plastic sheet being formed including interior detailing such as tray supports and the like in the side wall and/or rear wall portions thereof, said interior wall being spaced from said exterior wall by an insulation filled gap, but contacting said exterior wall at and along said seam, and said interior wall includes along each side of each said seam a transition face extending between said seam and the cabinet interior forming general part of said interior wall, opposed said transition faces abutting with said wall member folded.

5. A refrigerator cabinet as claimed in claim 4 wherein said twin walled insulated plastic member is divided into three wall sections, forming, when folded, the left side, rear, and right side walls sequentially, and said transition faces of said interior wall of said plastic member include an angle of approximately 90°.
6. A refrigerator cabinet as claimed in either claim 4 or claim 5 wherein at least one said transition face of said opposed pair of transition faces across each seam includes a channel formed longitudinally therein, such that an enclosed vertical shaft is formed by said abutting transition faces with said wall member folded, said shaft which may enclose refrigeration system components and/or ancillary components and/or including means to lock said abutting transition faces in said abutted condition or being empty.
7. A refrigerator cabinet as claimed in any one of claims 1 to 6 wherein said twin walled insulated plastic member is divided into three panels, forming sequentially a left side, back and right side wall of said refrigerator, said back wall panel of said wall member being preferably formed shorter than said left and right side wall panels of said wall member, said wall member thus having a notch formed in the bottom edge thereof, said notch extending between said elongate seams, said notch preferably allowing an open space at the back of said refrigerator adjacent said base plinth, said base plinth including said wall retaining channels along two opposed sides thereof, said channels retaining the bottom edge of each of said left and right side walls, to thereby connect to and retain said plastic wall member in said folded configuration.
8. A refrigerator cabinet for dual temperature refrigerators as claimed in any one of claims 1 to 7 wherein said cabinet includes a dividing partition dividing said cabinet into a fresh food and a freezer compartment, the lateral edges of said divider panel fitted within recesses formed in at least the interior faces of said left and right side walls of said cabinet.
9. A refrigerator cabinet as claimed in any one of claims 1 to 8 wherein including a floor means separate from said base plinth, said floor means comprises a bottom partition spanning between three or more sides of said folded plastic member, within the included space there between, said partition alone or in combination with said base plinth enclosing the bottom end of said refrigeration space.
10. A refrigerator cabinet as claimed in claim 9 wherein said base plinth includes on the top face thereof, along at least two sides thereof at or adjacent the periphery thereof, a recessed channel, the bottom edge of said folded plastic wall member fitted into said base plinth channel, said channel retaining the bottom edge of said wall member in said folded configuration.
11. A refrigerator cabinet as claimed in either claim 9 or claim 10 wherein said bottom

partition is substantially independent of said base plinth, and is fitted within a complementary recess or channel formed in the inwardly facing left and right side walls of said folded wall member, said partition having the rearward edge thereof substantially higher than the forward edge thereof.

12. A refrigerator cabinet as claimed in any one of claims 9 to 11 wherein said partition includes a substantially horizontal rearward portion, a substantially horizontal forward portion, and a transition therebetween, said left and right wall members having a channel therein to accommodating the left and right edges of said partition, said channel formed to correspond to the profile of said partition.

13. A refrigerator cabinet as claimed in any one of claims 9 to 12 wherein the interior face of the bottom edge of said back wall includes a rebate therein accommodating the rearward edge of said bottom partition.

14. A refrigerator cabinet as claimed in any one of claims 1 to 8 wherein the floor means is integrated with the base plinth, said base plinth includes a raised floor member, spanning between three or more sides of said folded plastic member and enclosing the bottom end of said refrigeration space, there being a space below said floor member and between downwardly extended fridge supporting members of said base plinth, said space adapted to receive mechanical and/or electrical components of said refrigerator.

15. A refrigerator cabinet as claimed in claim 14 wherein said downwardly extended fridge supporting members include means to connect to the bottom edge of at least the left and right sides of said cabinet.

16. A refrigerator cabinet as claimed in either claim 14 or claim 15 wherein said downwardly extended fridge supporting members each include a lateral extension having an upwardly facing channel formed there along into which the bottom edge of a respective left or right side wall of said cabinet is fitted.

17. A refrigerator cabinet as claimed in any one of claims 14 to 16 wherein said base plinth includes a removable tray adapted to carry said refrigerator mechanical components, said tray supported by said downward extensions, under said floor member.

18. A refrigerator cabinet as claimed in any one of claims 1 to 8 wherein a tray adapted to carry refrigerator mechanical components is formed integrally with said base plinth, below said floor means.

19. A refrigerator cabinet as claimed in any one of claims 14 to 17 wherein at least the upper face of said floor member includes a back plateau, a front plateau and a transition there between, and the inside surfaces of said left and right side cabinet walls include rebates at the bottom edges thereof which accommodate the lateral extremes of said floor member.

20. A refrigerator including a refrigerator cabinet as claimed in any one of claims 1 to 19, a door mounted on said refrigeration cabinet to enclose the front side of said refrigeration space and thereby fully enclose said refrigeration space, and a refrigeration system to refrigerate said refrigeration space, at least a part of said refrigeration system being mounted on said base plinth.

21. A method of forming a refrigerator cabinet comprising the steps of:

(a) thermoforming a twin walled insulated plastic member divided, by a plurality of elongate seams at which said twin walls contact, into three or more wall sections disposed sequentially in a side by side relation,

(b) folding said plastic wall member along each said seam to form three or more sides of a cabinet connected at said elongate seams, said sides defining a refrigeration space therebetween, and

(c) fitting a top end cap to said cabinet to retain said wall member in said folded configuration and enclose the top end of said refrigeration space, and

(d) fitting a base plinth to the bottom edge of said wall member to retain the bottom edge of said wall member in said folded configuration.

22. A method of forming a refrigerator cabinet as claimed in claim 21 including, prior to step (b), the steps of:

(i) while said plastic member is still retained in its thermoforming mould, introducing a foaming material into the cavity of each said wall section, said foaming material to expand as a foam and fill said cavities and to solidify therein, and

(ii) subsequently removing said plastic member from its thermoforming mould.

23. A method of forming a refrigerator cabinet as claimed in either claim 21 or claim 22 including, prior to folding said plastic wall member, removing an inner side mould half, and with said wall member still supported on the outer half of said thermoforming mould, heating said wall member in the region of said seams to substantially soften the material at said seams before folding.

24. A method of forming a refrigerator cabinet as claimed in claim 23 including, after removing said inner side mould half and before said folding, the step of laying a wiring harness and/or refrigerator mechanical components in channels formed on the inner face of said wall member.

25. A method of forming a refrigerator cabinet as claimed in any one of claims 21 to claim 24 wherein said wall member includes recessed channels in at least the left and right side forming portions thereof close to the bottom edge thereof and said method includes, when folding said plastic wall member to form said cabinet, retaining a bottom partition in position such that the left and right side edges of said bottom partition are retained in

said recesses of said wall member side forming portions upon folding.

26. A method of forming a refrigerator cabinet as claimed in any one of claims 21 to 25 including slidably fitting a dividing partition into channels formed in said left and right side wall forming portions of said wall member at a position intermediate of said top end cap and said bottom forming partition to form a fridge/freezer divider panel.

27. A cabinet including:

a twin walled plastic member divided, by a plurality of elongate seams at which said twin walls contact, into three or more wall sections disposed sequentially in a side by side relation, said member folded at said seams such that said sequence of wall sections form three or more sides of a cabinet connected at said elongate seams, and

a top and/or a bottom end cap, having generally an interior and an exterior face and having on the inner face along at least two sides thereof at or adjacent the periphery thereof a recessed channel, the top and/or bottom edge respectively of said folded plastic wall member fitted into said channel or channels, said channel or channels retaining said wall member in said folded configuration.

28. A cabinet as claimed in claim 27 wherein one or more of said folded seams do not coincide with the corner between sides of said cabinet that correspond to said wall sections joined by the respective said folded seam.

29. A cabinet as claimed in claim 27 wherein said twin walled plastic member has essentially an inner facing sheet and an outer facing sheet, and said member is formed adjacent at least one said seam such that said inner facing sheet contacts itself, said contact being between portions thereof on opposite sides of said seam and spaced from said seam, said contacting portions being fused to one another.

30. A cabinet for an appliance including a wall member formed by twin sheet thermoforming, said wall member incorporating a plurality of panels, said panels connected to one another by one or more joined edges where said twin sheets contact to form a seam, and in said appliance said wall member being in a folded condition along one or more of said seams such that said plurality of panels form a plurality of walls of said appliance, being, as a group, differently configured to when said wall member was initially thermoformed, wherein one or more of said folded seams do not coincide with the corner between walls of said appliance that correspond to the panels joined by the respective folded seam.

31. A cabinet as claimed in claim 30 wherein said respective folded seam is between an edge of one panel which forms an edge of the surface at least contributing to one said wall of said corner of said one panel, and the edge of another panel which forms an edge of a surface at an angle to the surface of said other panel at least contributing to the other

wall of said corner, said wall member folded at said seam, through said angle, such that said surface at an angle of said other panel contributes to said one said wall of said corner, and separates said folded seam from said corner.

32. A cabinet for an appliance including a wall member formed by twin sheet thermoforming, said wall member incorporating a plurality of panels, said panels connected to one another by one or more joined edges where said twin sheets contact to form a seam, and in said appliance said wall member being in a folded condition along one or more of said seams such that said plurality of panels form a plurality of walls of said appliance, being, as a group, differently configured to when said wall member was initially thermoformed, at least one said seam said twin walled plastic member having essentially an inner facing sheet and an outer facing sheet, and said member is formed adjacent at said seam such that in said folded condition said inner facing sheet contacts itself, said contact being between portions thereof on opposite sides of said seam and spaced from said seam, said contacting portions being fused to one another.

33. A cabinet as claimed in claim 32 wherein said contact between said portions of said inner sheet occurs along a line substantially coextensive with and parallel to said seam.

34. A wall member formed by twin sheet thermoforming including one or more seams where said twin sheets contact, said wall member adapted to be folded at one or more of said seams to form a plurality of walls, characterised in that at least one said seam is intended to be folded through a set angle, and that at least one said sheet of said twin sheets includes, at or substantially at said seam, a transition between surfaces thereof which is the complement of the said set angle, such that if said seam is folded through said set angle, said surfaces will be substantially continuous across said seam.

35. A wall member as claimed in claim 34 wherein one of said surfaces has another transition substantially parallel to said seam but spaced therefrom through the said set angle such that said surface after said further transition, away from said seam, is substantially co-planar with said surface before said first transition.

36. A wall member as claimed in claim 35 including a pair of said seams, parallel and spaced apart, dividing said wall member into three side-by-side panels, one sheet of said wall member having a substantially planar major surface associated with each panel, the three such major surfaces being substantially parallel, with said pair of seams being at opposed edges of the major surface of the middle said panel, and there being a perpendicularly extending minor surface of each of the two outer panels, each extending from the seamward edge of the major surface of the respective panel to the respective seam, said set angle being approximately 90 degrees such that if said seam is folded through said set angle, said minor surfaces of said outer panels will align with said major

surface of said middle panel, said outer panels will extend perpendicularly from the edges of said middle panel and the folded seams will be disposed entirely on the outer face of said middle panel.

37. Apparatus for preparing a twin sheet thermoformed wall member, including one or more seams at which said wall member is to be folded bringing included faces of said wall member at said seam together, for folding comprising a heat conductive head having a heating face configured to contact along said seams to be folded at, means to heat said heat conductive head, said head supported on a support means, which, together with a support means associated with said wall member is adapted to bring said head heating face into contact with said seam and by that contact allow the transfer of heat from said head to said seam and thereby soften said seam for folding.

38. Apparatus as claimed in claim 37 wherein said heating head includes one or more further heating faces configured to contact points of paths on one or more of said included faces of said wall member when the head heating face associated with said seam is brought into contact with said seam, said further heating faces thereby allowing the transfer of heat to locally soften or melt the plastic at said points or paths, such that if said included faces are brought together immediately subsequently by said folding operation the points or paths will form a point of bonding between such said included surfaces as are brought together.

39. A cabinet for a refrigerator substantially as herein described with reference to and as illustrated by Figures 1 to 5 of the accompanying drawings.

40. A method of forming a refrigerator cabinet substantially as herein described with reference to and as illustrated by the accompanying drawings.

41. A cabinet for an appliance including a corner arrangement substantially as herein described with reference to and as illustrated by Figure 9 of the accompanying drawings.

42. A cabinet for a refrigerator substantially as herein described with reference to and as illustrated by Figures 6 and 7 of the accompanying drawings.

43. A refrigeration cabinet formed by a method as claimed in any one of claims 21 to 26.

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FIG. 1

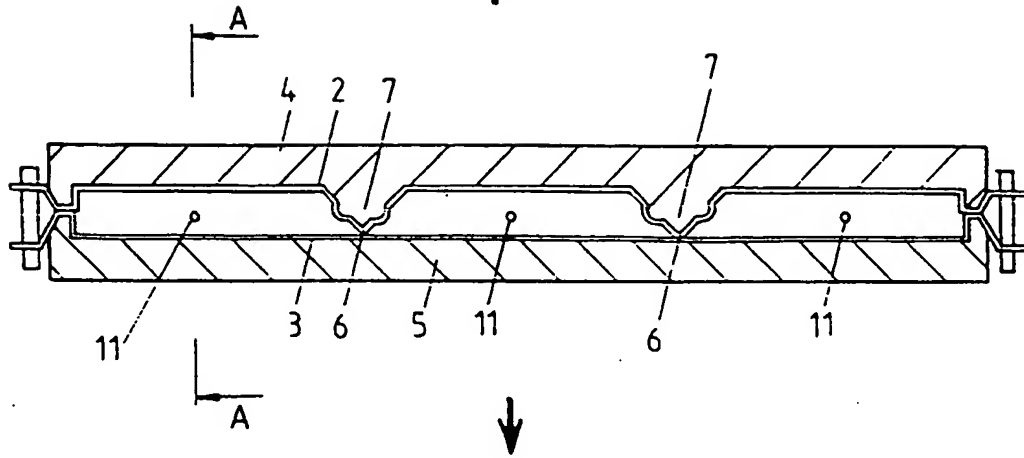


FIG. 2

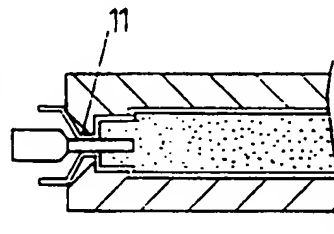
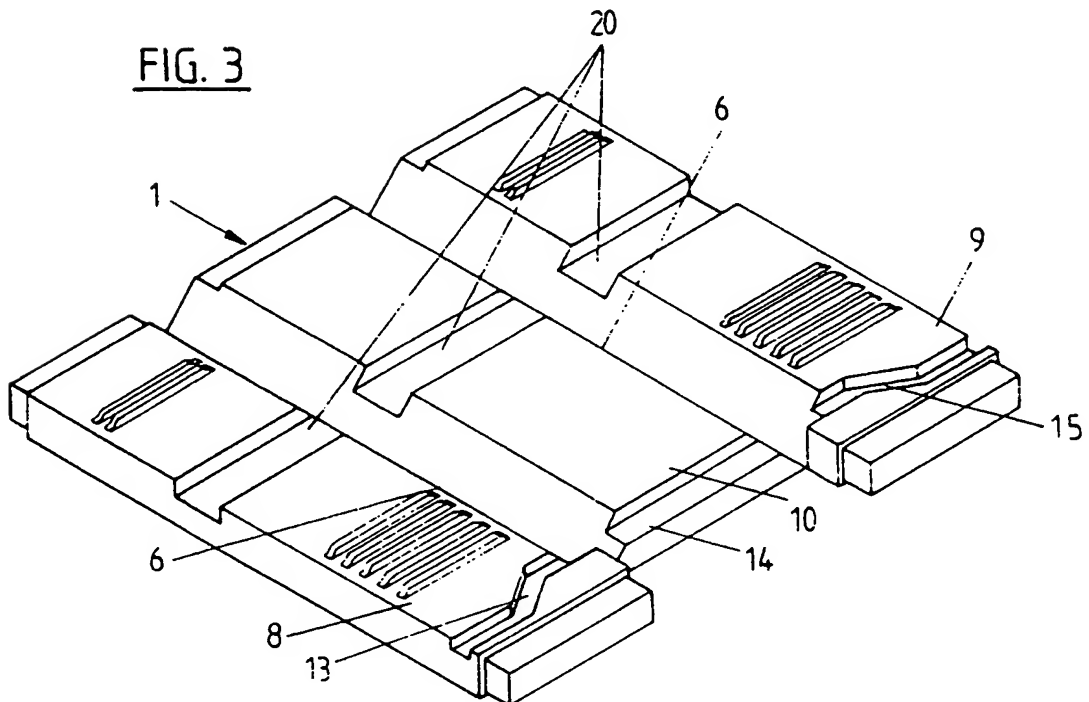


FIG. 3



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FIG. 4

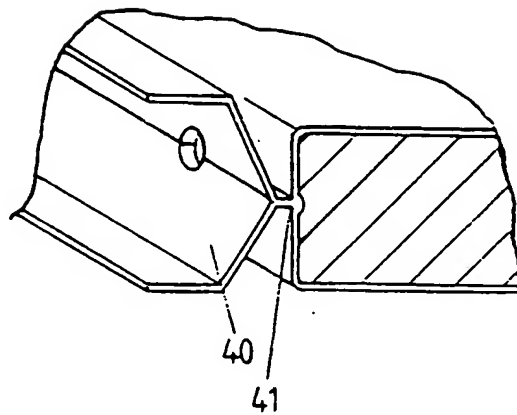


FIG. 6

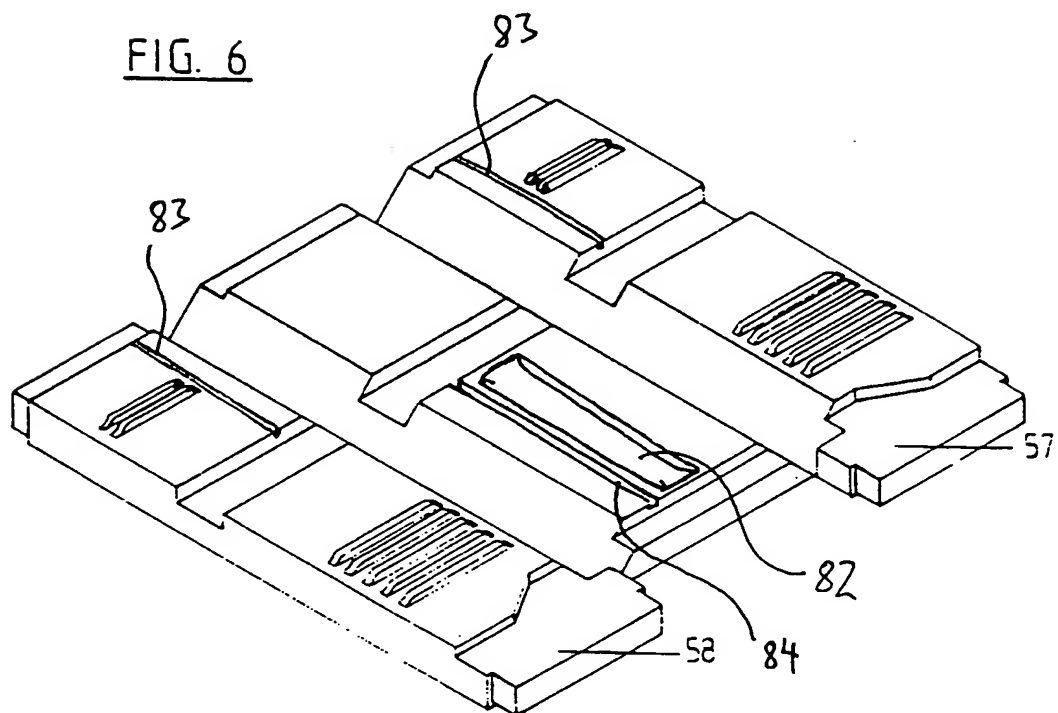
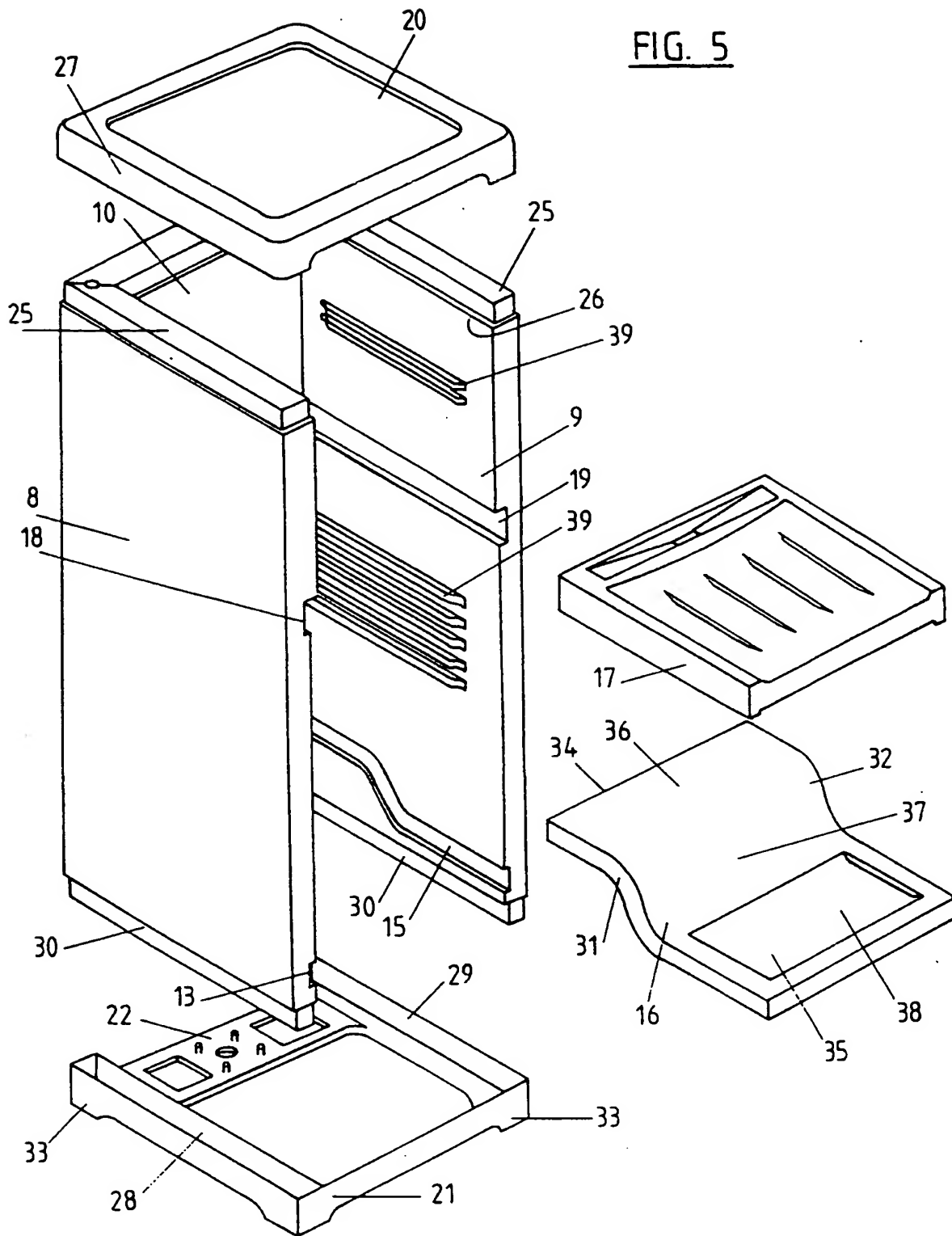
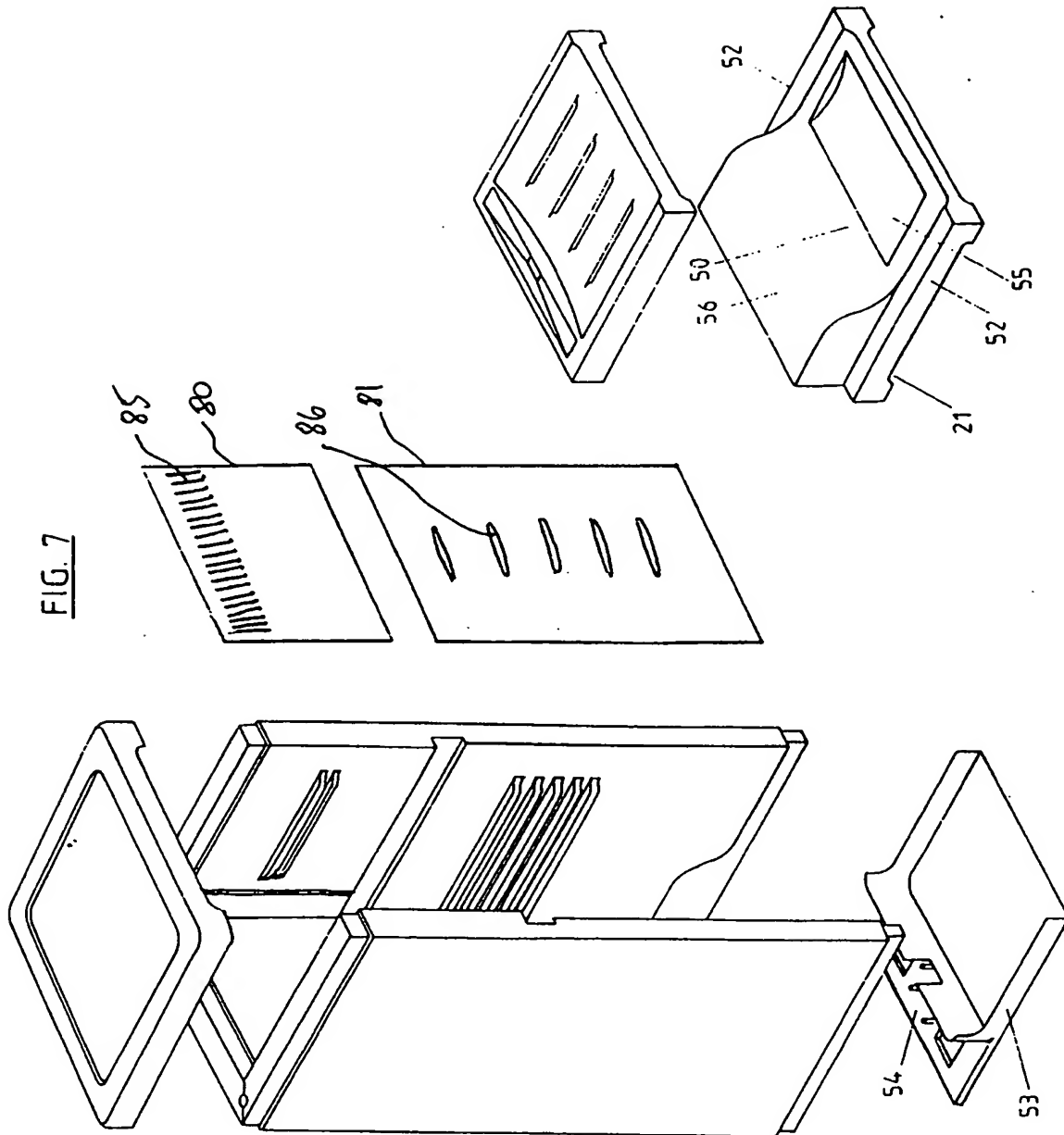
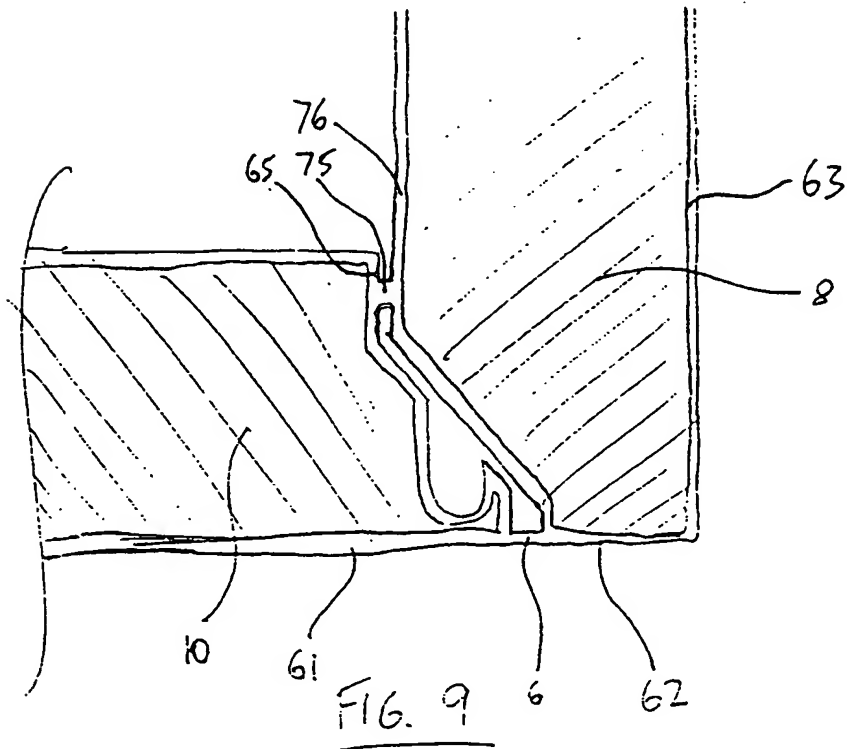
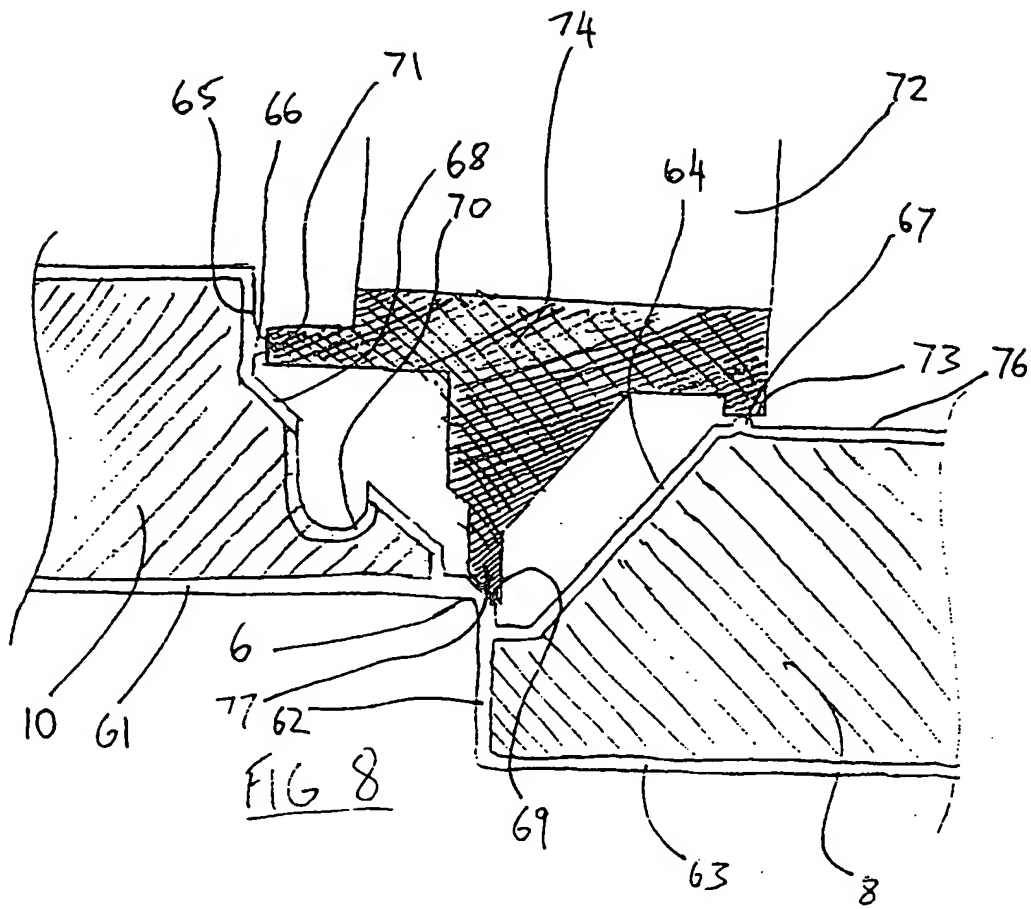


FIG. 5





INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ 98/00134

A. CLASSIFICATION OF SUBJECT MATTERInt Cl⁶: F25D 23/08, A47B 96/00, B29C 51/42, B29C 53/04, 53/84, 65/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC F25D 23/08, A47B 96/00, A47L 15/42, D06F 37/26, 58/20, B29C 51/42, 53/04, 53/40, 53/84, 65/18, 17/02, 17/03

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPAT: wall: OR panel: OR seam: OR join: OR fold:

JAPIO:

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5374118 A (KRUCK et al.) 20 December 1994 Column 14, line 63 to column 15, line 47, Figs. 15-19 Column 18, lines 1 to 40, Figs. 22-24 Column 21, lines 52 to 59, Fig. 37 Column 25, lines 23 to 41, Figs. 47-48	1-22, 27
A	US 4006947 A (HAAG et al.) 8 February 1977 Column 3, lines 1 to 37, Figs. 1-3	

☒ Further documents are listed in the continuation of Box C☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

12 February 1999

Date of mailing of the international search report

19 FEB 1999

Name and mailing address of the ISA/AU

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ 98/00134

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5168621 A (KRUCK et al.) 8 December 1992 Column 14, line 60 to column 15, line 44, Figs. 15-19	
A	Derwent Abstract Accession No. 97-276037/25, Class A32, JP 09-099483-A (TSUTSUNAKA PLASTIC IND CO LTD) 15 April 1997 Abstract	
A	GB 2085797 A (TERAOKA et al.) 6 May 1982 Entire document	
P,A	EP 0839633 A2 (THE BOEING COMPANY) 6 May 1998 Page 3, line 54 to page 4, line 25	37
A	AU 36360/78 A (GAULT) 29 November 1979 Page 4, Figs. 1-2	37

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ 98/00134

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 39-42
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
they do not comply with Rule 6.2 (a)
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Refer additional sheet attached herewith.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International Application No.
PCT/ NZ 98/00134

Supplemental Box

(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: II

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are at least two inventions:

1. Claims 1, 21 and 27 are directed to a refrigerator cabinet comprising a twin walled insulated plastic member divided into three or more wall sections by a plurality of elongate seams at which the said twin walls contact each other, wherein the member is folded at the seams such that the wall sections form three or more sides of a cabinet. The cabinet also comprises top and base end caps which retain the member in a folded configuration and enclose the top and bottom ends respectively of the refrigeration space. It is considered that the provision of multiple wall sections by making elongated seams and folding the member at these seams, as also the particular combination of the folded plastic member and the top and bottom end caps comprises a first "special technical feature".
2. Claims 30 and 32 are directed to a cabinet for an appliance, including a wall member formed by twin sheet thermoforming which incorporates a plurality of panels. The panels are interconnected at seams which comprise the joining points of the twin sheets, the wall member being folded at these seams such that the panels form a plurality of walls for the cabinet. The panels are, as a group, differently configured in the folded state of the wall member as compared to when it is initially thermoformed. This feature is considered to comprise a second "special technical feature".
3. Claim 34 is directed to a wall member formed by twin sheet thermoforming, includes one or more seams where the twin sheets contact, and can be folded at one or more of these seams to form a plurality of walls. At least one of the seams is designed to be folded through a set angle, and at least one of the twin sheet includes a transition between its surfaces at, or substantially at, this seam which is the complement of the said set angle. This feature is considered to comprise a third "special technical feature".
4. Claims 37 and 38 are directed to an apparatus for preparing a twin sheet thermoformed wall member, which comprises a heat conductive head having a heating face configured to contact the seams to be folded, means to heat the heat conductive head, support means for the head, and support means for the wall member which is to be heated. The adaptation of the heat conductive head and the two support means in such manner as to bring the heating face of the head into contact with the seam is considered to comprise a fourth "special technical feature".

Since the above-mentioned groups of claims do not share any of the technical features identified, a "technical relationship" between the inventions, as defined in PCT Rule 13.2, does not exist. Accordingly, the international application does not relate to one invention or to a single inventive concept. However, because the inventions defined by the second and third groups of claims can be searched without involving significant extra effort, this Authority does not invite payment of any additional fee for these groups of claims.

The fourth group of claims (37, 38) have distinct classifications under the IPC and therefore it is considered that because of these distinct classifications, constitute separate search areas. The invention defined by these claims cannot be searched without involving significant extra effort.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/NZ 98/00134

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	5374118	US	5168621	BR	8906143	IT	1237308
US	5168621	US	5374118	BR	8906143	IT	1237308
GB	2085797	BR	8105161	DE	3128221	FR	2492312
		JP	57070353	US	4423000	US	4592718
		JP	57156211	JP	57157726		
EP	839633	CA	2213795	CN	1176878	EP	839633
END OF ANNEX							